

WHAT IS CLAIMED IS:

- 1 1. An apparatus for an internal combustion engine,
2 comprising:
3 a variation calculating section to calculate a variation
4 of an engine oil-diluting fuel which is fuel leaking out
5 through a clearance between a piston and a cylinder of the
6 engine and diluting an engine oil; and
7 an oil-diluting fuel quantity calculating section to
8 determine an oil-diluting fuel quantity in accordance with
9 the variation.
- 1 2. The apparatus as claimed in Claim 1, wherein the
2 variation calculating section calculates the variation in
3 accordance with an engine temperature.
- 1 3. The apparatus as claimed in Claim 1, wherein the
2 variation calculating section comprises an increase
3 calculating section to calculate an increase quantity of the
4 engine oil-diluting fuel quantity, and a decrease calculating
5 section to calculate a decrease quantity of the engine oil-
6 diluting fuel quantity; and the oil-diluting fuel quantity
7 calculating section calculates the oil-diluting fuel quantity
8 in accordance with the increase quantity and the decrease
9 quantity.
- 1 4. The apparatus as claimed in Claim 3, wherein the
2 increase calculating section calculates the increase quantity
3 of the engine oil-diluting fuel quantity in accordance with
4 an engine temperature, an engine speed and an engine
5 load.

1 5. The apparatus as claimed in Claim 4, wherein the
2 engine temperature is an engine cylinder wall temperature.

1 6. The apparatus as claimed in Claim 3, wherein the
2 decrease calculating section calculates the decrease
3 quantity of the engine oil-diluting fuel quantity in
4 accordance with an engine temperature, and an engine
5 speed.

1 7. The apparatus as claimed in Claim 6, wherein the
2 engine temperature is an engine oil temperature.

1 8. The apparatus as claimed in Claim 3, wherein the
2 decrease calculating section calculates a decrease rate
3 which is a rate of decrease of the oil-diluting fuel quantity,
4 and which represents a rate of evaporation of the oil-
5 diluting fuel, to determine the decrease quantity in
6 accordance with the decrease rate.

1 9. The apparatus as claimed in Claim 1, wherein the oil-
2 diluting fuel quantity calculating section calculates the oil-
3 diluting fuel quantity by integrating the variation.

1 10. The apparatus as claimed in Claim 9, wherein the
2 variation calculating section determines a value of the
3 variation periodically, and the oil-diluting fuel quantity
4 calculating section calculates the oil-diluting fuel quantity
5 by adding a current value of the variation to a previous
6 value of the oil-diluting fuel quantity.

1 11. The apparatus as claimed in Claim 9, wherein the
2 variation calculating section comprises an increase
3 calculating section to calculate an increase quantity of the
4 engine oil-diluting fuel quantity, and a decrease calculating
5 section to calculate a decrease quantity of the engine oil-
6 diluting fuel quantity; and the oil-diluting fuel quantity
7 calculating section calculates the oil-diluting fuel quantity
8 by integrating the increase quantity and the decrease
9 quantity.

1 12. The apparatus as claimed in Claim 11, wherein the
2 increase calculating section calculates the increase quantity
3 of the engine oil-diluting fuel quantity in accordance with
4 an engine cylinder wall temperature, an engine speed and
5 an engine load, and wherein the decrease calculating
6 section calculates the decrease quantity of the engine oil-
7 diluting fuel quantity in accordance an engine oil
8 temperature and the engine speed.

1 13. The apparatus as claimed in Claim 1, wherein the
2 variation calculating section determines an oil-diluting
3 temperature component quantity for each of engine
4 temperature regions, and the oil-diluting fuel quantity
5 calculating section calculates the oil-diluting fuel quantity
6 from the oil-diluting temperature component quantities.

1 14. The apparatus as claimed in Claim 13, wherein the
2 variation calculating section varies the oil-diluting

3 temperature component quantity of each temperature
4 region in accordance with an engine temperature.

1 15. The apparatus as claimed in Claim 14, wherein the
2 variation calculating section comprises an increase
3 calculating section to calculate an increase quantity of the
4 engine oil-diluting fuel quantity, and a decrease calculating
5 section to calculate a decrease quantity of the engine oil-
6 diluting fuel quantity; and the oil-diluting fuel quantity
7 calculating section updates a collection of the oil-diluting
8 temperature component quantities in accordance with the
9 increase quantity and the decrease quantity, and calculates
10 the oil-diluting fuel quantity by using the collection updated.

1 16. The apparatus as claimed in Claim 15, wherein the
2 increase calculating section calculates the increase quantity
3 of the engine oil-diluting fuel quantity in accordance with
4 an engine cylinder wall temperature, an engine speed and
5 an engine load, and wherein the decrease calculating
6 section calculates the decrease quantity of the engine oil-
7 diluting fuel quantity in accordance an engine oil
8 temperature and the engine speed.

1 17. The apparatus as claimed in Claim 15, wherein the oil-
2 diluting fuel quantity calculating section adds the increase
3 quantity to each of the oil-diluting temperature component
4 quantities in the collection.

1 18. The apparatus as claimed in Claim 15, wherein the oil-
2 diluting fuel quantity calculating section decreases the oil-

3 diluting temperature component quantity of each
4 temperature region if the temperature region is a region
5 lower than or equal to a current engine temperature.

1 19. The apparatus as claimed in Claim 1, wherein the
2 apparatus further comprises a condition discriminating
3 section to check the oil-diluting fuel quantity to determine
4 whether a predetermined permitting condition is satisfied,
5 and an alcohol concentration calculating section to
6 calculate an alcohol concentration of a fuel when the
7 permitting condition is satisfied.

1 20. The apparatus as claimed in Claim 19, wherein the
2 permitting condition is satisfied when the oil-diluting fuel
3 quantity is smaller than or equal to a predetermined value.

1 21. The apparatus as claimed in Claim 19, wherein the
2 permitting condition is satisfied when at least one of first
3 and second conditions is satisfied, the first condition being
4 a condition which is satisfied when the oil-diluting fuel
5 quantity is smaller than or equal to a predetermined value,
6 the second condition is a condition which is satisfied when
7 the variation of the oil-diluting fuel quantity is smaller than
8 or equal to a predetermined variation value.

1 22. The apparatus as claimed in Claim 1, wherein the oil-
2 diluting fuel quantity calculating section modifies the oil-
3 diluting fuel quantity in accordance with a fuel injection
4 quantity of fuel injected into the engine.

1 23. The apparatus as claimed in Claim 1, wherein the
2 apparatus comprises an engine control section to control
3 the engine in accordance with the oil-diluting fuel quantity.

1 24. The apparatus as claimed in Claim 23, wherein the
2 engine control section adjusts a fuel injection quantity in
3 accordance with the oil-diluting fuel quantity.

1 25. A process for an internal combustion engine, the
2 process comprising:
3 calculating a variation of an engine oil-diluting fuel
4 which is fuel leaking out through a clearance between a
5 piston and a cylinder of the engine and diluting an engine
6 oil; and
7 determining an oil-diluting fuel quantity in accordance
8 with the variation.

1 26. An engine control system of an internal combustion
2 engine, the system comprising:
3 an input section to sense an engine operating
4 condition;
5 a control unit to calculate a variation of an engine oil-
6 diluting fuel which is fuel leaking out through a clearance
7 between a piston and a cylinder of the engine and diluting
8 an engine oil, to determine an oil-diluting fuel quantity in
9 accordance with the variation, and to produce a control
10 signal by using the oil diluting fuel quantity; and
11 an output section to control the engine in response to
12 the control signal.

1 27. An apparatus for an internal combustion engine, the
2 apparatus comprising:
3 means for calculating a variation of an engine oil-
4 diluting fuel quantity successively in accordance with an
5 engine temperature; and
6 means for determining the oil-diluting fuel quantity in
7 accordance with successively calculated values of the
8 variation.